

Q1.

When a large object moves in air, there is a resistive force on it whose magnitude is given by: $F = 0.5 D \rho B v^2$, where D is a dimensionless constant, ρ is the density of the air and v is the speed of the object. What are the dimensions of B ?

- A) L^2
- B) M^2
- C) T^2
- D) ML^2
- E) TM^2

Q2.

A cubic box has a side of length 1.00 ft. What is the volume of the box in cubic meters?
(1 ft = 12.0 inch, 1 inch = 2.54 cm)

- A) 0.0283
- B) 0.843
- C) 0.759
- D) 0.227
- E) 0.00100

Q3.

A car is travelling along a straight line. It travels at 40.0 km/h for 2.00 h, then at 50.0 km/h for 1.00 h, and finally at 20.0 km/h for 0.500 h. What is the average speed of the car?

- A) 40.0 km/h
- B) 36.7 km/h
- C) 55.0 km/h
- D) 45.0 km/h
- E) 31.6 km/h

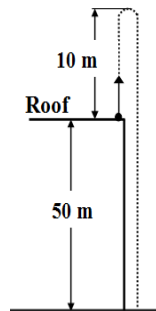
Q4.

In one dimensional motion, a particle is 5.00 m east of the origin and is moving west with a speed of 2.00 m/s. Five seconds later, it is 11.0 m east of the origin. What is its acceleration? Assume that the acceleration is constant.

- A) 1.28 m/s^2
 - B) -0.320 m/s^2
 - C) 2.08 m/s^2
 - D) 1.68 m/s^2
 - E) 0.781 m/s^2
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Q5.

An object is thrown vertically upward from the roof of a building that is 50 m high. It rises to a maximum height of 10 m above the roof (**Figure 1**). When is it 20 m below the roof?



- A) 3.9 s
- B) 5.2 s
- C) 4.9 s
- D) 3.2 s
- E) 6.1 s

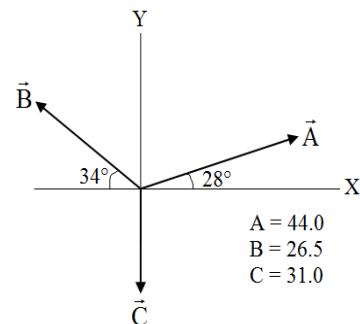
Q6.

At time $t = 3.0$ s, the velocity of a particle, moving along the x -axis with constant acceleration, is $v = + 4.0$ m/s. At $t = 7.0$ s, its velocity is $v = -12$ m/s. Find the velocity at $t = 0$.

- A) + 16 m/s
- B) + 20 m/s
- C) - 16 m/s
- D) - 20 m/s
- E) + 5.0 m/s

Q7.

For the three vectors ($\vec{A}, \vec{B}, \vec{C}$) shown in **Figure 2**, find $\vec{C} \times (\vec{A} \times \vec{B})$.



- A) $-3.19 \times 10^4 \hat{i}$
- B) $-6.27 \times 10^4 \hat{i}$
- C) $+2.67 \times 10^4 \hat{i}$
- D) $+3.67 \times 10^4 \hat{i}$
- E) zero

Q8.

What is the angle between two vectors $\vec{A} = 20\hat{i}$ and $\vec{B} = -25\hat{i} + 30\hat{j}$?

- A) 130°
- B) 150°
- C) 160°
- D) 140°
- E) 110°

Q9.

A body moves from a position with coordinates (1.0, 2.0) m to (-4.0, 2.0) m. Its displacement vector is given by

- A) 5.0 m at 180°
- B) 5.0 m at 135°
- C) 1.7 m at 297°
- D) 5.0 m at 0°
- E) 5.2 m at 108°

Q10.

At time $t = 0$, a particle leaves the origin with a velocity of 9.0 m/s in the positive y -direction and moves in the xy plane with a constant acceleration of $(2.0\hat{i} - 4.0\hat{j})$ m/s². What is the speed of the particle when its x -coordinate is +15 m?

- A) 10 m/s
- B) 16 m/s
- C) 12 m/s
- D) 14 m/s
- E) 26 m/s

Q11.

A projectile is launched from the ground at time $t = 0$. When $t = 5.00$ s, its velocity is given as: $\vec{v} = 25.0\hat{i} - 30.0\hat{j}$ (m/s). Find the maximum height of the projectile.

- A) 18.4 m
- B) 15.6 m
- C) 32.9 m
- D) 65.8 m
- E) 49.4 m

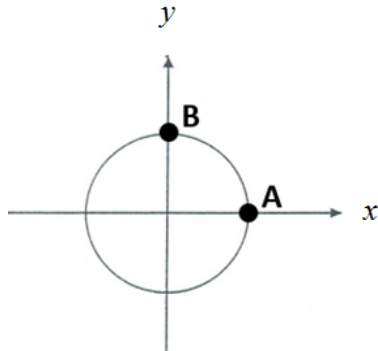
Q12.

A river, of width 150 m, flows with a uniform speed of 4.0 m/s toward the east. It takes 20 s for a boat to cross the river from a point on the south side to the opposite point on the north side. What is the speed of the boat relative to the water?

- A) 8.5 m/s
- B) 9.1 m/s
- C) 5.7 m/s
- D) 7.0 m/s
- E) 6.4 m/s

Q13.

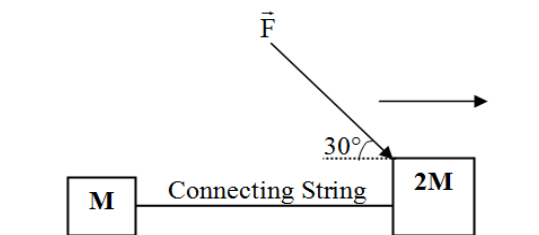
A particle undergoes counterclockwise uniform circular motion around a circle of radius 5.0 m with a period of 3.2 s, as shown in **Figure 3**. In a quarter of a period, as the particle moves from A to B, what is the magnitude of the average velocity of the particle?



- A) 8.8 m/s
- B) 9.8 m/s
- C) 4.9 m/s
- D) 7.8 m/s
- E) zero

Q14.

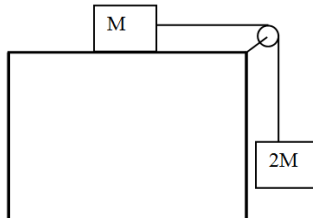
In **Figure 4**, the force \vec{F} acts to move the two blocks on a horizontal frictionless surface. Find the magnitude of the tension in the massless connecting string. Take $F = 15$ N, $M = 1.5$ kg.



- A) 4.3 N
- B) 5.9 N
- C) 5.1 N
- D) 3.8 N
- E) 6.2 N

Q15.

The two blocks shown in **Figure 5** are released from rest and are observed to have an acceleration of 1.5 m/s^2 . What is the magnitude of the frictional force on the block that slides horizontally? Assume the pulleys and strings are massless, and take $M = 1.4 \text{ kg}$.



- A) 21 N
- B) 46 N
- C) 11 N
- D) 37 N
- E) 29 N

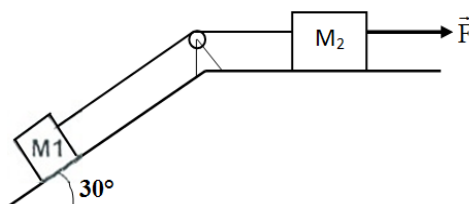
Q16.

An 80-kg man stands in an elevator that has a downward acceleration of 1.5 m/s^2 . The magnitude of the force exerted by the man on the floor of the elevator is

- A) 664 N
- B) 784 N
- C) 904 N
- D) 388 N
- E) zero

Q17.

Two blocks with masses $M_1 = 3.0 \text{ kg}$ and $M_2 = 5.0 \text{ kg}$ are connected by a light rope and move on a frictionless surface, as shown in **Figure 6**. A force $F = 20 \text{ N}$ acts on M_2 as shown in the figure. Find the magnitude of the acceleration of the system.



- A) 0.66 m/s^2
- B) 2.6 m/s^2
- C) 1.8 m/s^2
- D) 4.3 m/s^2
- E) 0.86 m/s^2

Q18.

A car moves on a level horizontal road in a circle of radius 40 m. The coefficient of static friction between tires and road is 0.50. The maximum speed with which this car can round this curve without sliding is

- A) 14 m/s
- B) 12 m/s
- C) 16 m/s
- D) 10 m/s
- E) 18 m/s

Q19.

Which of the following statements is **TRUE**?

- A) A particle can be in equilibrium and yet moving.
- B) A stone that has been thrown vertically upward reverses its acceleration as it reaches the top of its trajectory.
- C) Two vectors of unequal magnitudes can add up to zero.
- D) On a displacement-time graph, a straight line with positive slope indicates motion at increasing speed.
- E) The action and reaction forces act on the same object.

Q20.

Which of the following statements is **TRUE**?

- A) A car can be accelerating while moving at constant speed.
 - B) If an object is released from rest, it falls 9.8 m during the first second of its motion.
 - C) The velocity of a projectile equals its initial velocity added to a constant horizontal velocity.
 - D) A particle can move with uniform velocity along a circular path.
 - E) The velocity of a projectile at the top of its trajectory is zero.
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